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ABSTRACT

In recognition of the vital role socio-cultural variables play in science classrooms, researchers are now beginning to call attention to, and encourage serious considerations of the socio-cultural background of pupils which affect their learning and understanding of science. An effective point to begin the empirical study of socio-cultural influences in science classrooms is the development of an instrument to identify these influences. This paper describes the development, revision, and validation of a 30-item, Likert-like instrument called the Socio-Cultural Environment Scale (SCES) to measure the socio-cultural environment of science classrooms in a non-western society. The instrument was developed after a content validation by science educators, sociologists, science teachers, and anthropologists and was administered to a total of 707 grade 11 and 12 secondary school students to determine the internal consistency reliability and construct validity of the items. The SCES has a Chronbach alpha reliability of 0.92; inter-item correlations ranged from 0.48 to 0.96; and the intra-scale consistency for the five scales identified ranged from 0.70 to 0.98. Factor analysis of the data indicated that the items on the instrument clustered into social and cultural entities. The educational implications of this study are discussed. (Author/CW)

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DEVELOPMENT AND VALIDATION OF AN INSTRUMENT TO MEASURE THE SOCIO-CULTURAL ENVIRONMENT IN SCIENCE CLASSROOMS.

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Development and Validation of an Instrument to Measure the Socio-Cultural Environment in Science Classrooms.

ABSTRACT

This paper describes the development, revision, refinement and validation of an instrument - the Socio-Cultural Environment Scale (SCES) - to measure the socio-cultural environment of science classrooms in a non-western society. In recognition of the vital role socio-cultural variables play in science classrooms, researchers are now beginning to call attention to, and encourage serious considerations, of socio-cultural background of pupils which affect their learning and understanding of science . An effective point to begin the empirical study of socio-cultural influences in science classrooms is the development of an instrument which could be used to identify the influences. A 30-item Likert-type instrument emerged after a series of content validation using expert judges comprising of science educators, sociologists, science teachers, anthropologists to determine how relevant and representative the items are to the dimensions being studied. The instrument was administered to a total of 707 class 4 and 5 (grade 11 and 12) secondary school students to determine the internal consistency reliability and the construct validity of the items. The SCES has a Cronbach alpha reliability of 0.92; inter-item correlations ranged from 0.48 to 0.96 and the intra scale consistency for the five scales identified ranged from 0.70 to 0.98. Factor analysis of the data indicated that the items on the instrument clustered into social and cultural entities. The educational implications of the study was discussed.

INTRODUCTION AND THEORETICAL FRAMEWORK

It has long been recognized that the life within the classroom (generally referred to as classroom climate) - the environment and its interaction with personal characteristics of the individual-determines to a very large extent the purpose and direction of human behaviour (Lewin, 1936). Classroom environment as defined by Fraser (1989a) is seen as shared perceptions of the students and teachers in that environment.

The equivocal nature of the effect of classroom environment in both the cognitive and affective outcomes of schooling has led to the emergence of a flurry of research activities in this area in contemporary times (Walberg, 1986; Good, 1989; Fraser, 1989b; Knuver and Brandsma, 1989).

To date, a sizeable amount of studies has been done to illuminate the social and psychological aspects of the learning environments of school classrooms. And as recently reviewed (Fraser, 1986), several instruments for assessing the psycho-social classroom environment have emerged within the past twenty years of active work on classroom climate. Some of these instruments include the Learning Environment Inventory (LEI), Classroom Environment Scale (CES), Individualized Classroom Environment Questionnaire (ICEQ), My Class Inventory (MCI) and Science Laboratory Environment Inventory (SLEI) to mention but a few.

In its most simplistic form, the sum total of studies in the psycho-social aspects of classroom climate is that several classroom climate variables, e.g., task orientation, order and organization, teacher support, teacher control and innovation, goal direction, cohesiveness, etc., are strongly related to cognitive and affective outcomes of science education.

Despite the vigorous efforts in classroom environment studies, it does appear that the socio-cultural aspect of the classroom has not received the much needed focus it merits from investigators. Some would argue (Erickson, 1984; Maddock, 1981; Hvifeldt, 1986) that since education, as a cultural and human enterprise, involves the transmission of cultural heritage of a people, every investigation or study of human associations should infact be subsumed under the socio-cultural umbrella. The learning of science, particularly in non-western cultures, where there seems to be apparent unrelatedness between school science and common knowledge, often calls into question beliefs and practices which form composite part of the contemporary culture.

There is evidence in the general literature which strongly leads to the need to hypothesize that socio-cultural variables are attendant to the effective achievement of intended learning outcomes in science education (Champagne, 1984; D'Ambrosio, 1985; Driver, 1979; Bajah, 1975). Unfortunately, however, empirical evidence to support or reject this theoretical proposition has not been forthcoming (Jegede, 1987; Jegede and Okebukola, 1988).

A number of arguments could be advanced to support the need for researchers to begin to focus seriously on other aspects of the psycho-social environment in the science classroom with specific reference to socio-cultural influences. First, irrespective of the geographical location, the environment of a classroom mirrors the social and cultural aspects of the larger society through the daily interaction of the students and teachers. Second, a considerable amount of work done on the psycho-social environment has provided evidence to indicate that several measures of classroom climate are associated with learning outcomes (Walberg, 1969; Fraser and Fisher, 1982; Fraser, 1989a). There is the need to investigate other areas of classroom climate for a more comprehensive information on classroom environment. In the particular case of the non-western classrooms, there is the need to focus on the socio-cultural parts of classroom climate which are of utmost importance in the teaching and learning process. Third, identifying and measuring the social cultural factors intervening in classroom processes would help put in proper perspective the role which socio-cultural factors play in the study and learning of concepts in science. Fourth, in developing non-western cultures where scientific knowledge and interpretations of natural phenomena, of instructional methods and of teacher and student behaviours are at variance with the prevailing global conventions, the socio-cultural dimensions of classroom climate become very important (Jegede, 1987).

Solomon (1987) and Millar and Driver (1987) have attempted to bring to the fore the social and cultural issues about pupils' construction of meaning and knowledge which the literature seemed to have ignored. They argue that the way the learner construes his/her immediate world serves as the framework for understanding scientific concepts. Related to the above are the social and cultural characteristics of everyday language of communicating science. Nussbaum (1989) asserts that the elements of everyday language represent intuitive perceptions and beliefs which are culturally influenced. These influences through the learners language and the 'unspoken expectations of the learner's culture' (Solomon, 1987), constitute the testing ground for our ideas (cognitive structures) of the experiential world (Glassersfield, 1989). These reinforce Toulmin's (1972) call for research into the features of social and cultural context influencing the understanding of science.

In recognition of the vital role socio-cultural variables play in science classrooms, researchers are now beginning to call attention to, and encourage serious considerations, of socio-cultural background of pupils which affect their learning and understanding of science (Gallagher and Dawson, 1984; Okebukola and Jegede, 1989). A logically and realistically good point to begin the empirical study of socio-cultural influences in science classrooms is the development of an instrument which could be used to identify the influences.

This study therefore developed and validated an instrument which is useful in measuring socio-cultural factors in science classrooms.

METHODS

Instrument development and Initial Validation

A series of steps were taken for the development and validation of the Socio-Cultural Environment Scale (SCES). A detailed search of the research literature was undertaken to identify indicators or aspects of the socio-cultural environment. An initial pool of 50 items was developed for the seven indicators identified. Approximately 30 per cent of the initial 50 items assembled were negatively worded to check, in some measure, the reliability of responses. Each item was formatted on a three point response of 'Never', 'Sometime' and 'Often'. Examples of the items are (i) traditional beliefs have scientific explanations, (ii) the African culture emphasizes respect for elders' (teachers') point of view in the science class. Face validity was established to reveal consistency of the items generated with the general understanding of socio-cultural environment in a traditional African society.

Content Validity

Content validation was undertaken to determine how representative and relevant the items are to the dimensions of the socio-cultural factors under investigation (Scharmann, Harty and Holland, 1986). Each item was validated against the following specifications: (i) direct or indirect reference to the stated socio-cultural factors; (ii) each factor should be represented by at least three items; (iii) the items in the instrument should reflect respondent's attitude toward socio-cultural factors in the classroom; and (iv) each statement is readable by secondary school students. The items were then subjected to a series of validation by expert judgement. Each item was submitted to a set of 12 judges consisting of sociologists, anthropologists, science educators and science teachers for their scrutiny and comment. They were selected on the basis of their familiarity with the social and cultural environment of the African society, science content taught at the secondary school level, experience with teaching pupils for which the instrument was meant and expertise in writing items for questionnaire-type instrument. The validators were requested to cancel, add, modify, rewrite or suggest modification to, items. Their responses resulted in the elimination of 14 items, cancellation of a subscale and the modification and rewriting of some items. The panel of judges were again asked to validate the second version to critically assess if they, in addition to meeting the characteristics set outlined above, meet with the objectives of the study as stated on a sheet of paper which accompanied the items of the instrument. They were also to judge the significance of the socio-cultural factors represented, and to comment on the clarity and possible understanding of the statements contained in the items by the target population. A coefficient of interrater reliability determined through the Scott's method (Scott, 1955) was 0.90 for the 12 adjudicators. After the validation processes were completed, the second version of the instrument was revised in relation to the recommendations made by the validators. As a result of the revision process, the number of predictors was reduced to five and the number of items from 36 to 30. The final set of

30 items was named the "Socio-Cultural Environment Scale" (or SCES). The SCES subscales and examples of items corresponding to the subscales are as follows:

Subscale 1: Authoritarianism (Nature of the Class)

Examples of Items for Subscale 1:

1. The African culture emphasizes respect for elders' (teachers') point of view.
2. Students freely express their mind during science lessons.

Subscale 2: Goal Structure (Cooperative, Competitive or Individualistic)

Examples of Items for Subscale 2:

1. Students work cooperatively in groups during science activities.
2. The science teacher provides projects that encourage cooperative group work.

Subscale 3: Traditional (African) Worldview (Beliefs and Superstitions)

Examples of Items for Subscale 3:

1. Traditional beliefs have scientific explanations.
2. Supernatural forces control events and happenings in the world.

Subscale 4: Societal Expectation (Motivation from Society)

Examples of Items for Subscale 4:

1. My friends expect me to do well in science.
2. The prestige science enjoys in the society is responsible for my studying it.

Subscale 5: Sacredness of Science (Magic or Mysticism)

Examples of Items for Subscale 5:

1. Science concepts have magical explanations attached to them.
2. The things to learn in science are strange to me.

FIELD TESTING AND MEASUREMENT OF SOCIO-CULTURAL FACTORS

The preliminary field testing and construct validation involved administering the 30 items in the five subscales to a sample of 707 senior secondary school students in classes 4 and 5 (grades 11 and 12) randomly drawn from urban and rural areas in four states of Nigeria. The sample, which was made up of 470 boys and 237 girls, had an age range of 14 to 19 years, with a mean age of 17.

Internal Consistency Reliability

An internal consistency reliability was determined to check if the items on the SCES exhibit homogeneity in relation to the socio-cultural construct being investigated. The final version (30 items) of the SCES was administered to the sample of 707 students used in this study.

The inter-item covariances of the items on the SCES ranged from 0.14 to 1.41, while the interscale correlations ranged from .09 to .33. The inter-item correlations as shown in Table I ranged from 0.48 to 0.96; all the items therefore attracted a correlation higher than the .30 which Shrigley (1983) suggested should be the least to justify an acceptable discrimination index of an item. The alpha coefficient ranged from 0.88 to 0.96 with a highly significant Hotellings T-squared ($F=51.5$, $p<.001$) and the intra scale consistency coefficient ranged from 0.70 to 0.98. The Spearman Brown corrected split-half reliability of the SCES for the sample in this study and the Cronbach alpha reliability were computed to be 0.92, thus indicating satisfactory internal consistency reliability for all 30 items of the subscales. In view of the fact that Cramo and Brewer (1973) recommended a minimum alpha coefficient of internal consistency reliability of 0.80 for Likert-type scales, the alpha reliability of 0.92 for the SCES appears highly acceptable.

TABLE I ABOUT HERE

Further validation

Further validation was done on the basis of the results of very satisfactory results of the content validity and internal consistency reliability already carried out at the initial process of the development of the SCES. This was to further validate the major constructs within the socio-cultural instrument. A factor analytic technique was used for this in order to accomplish three things.

First, it was done to discover underlying factors and patterns among the variables. As stated by Ferguson (1981), one purpose of factor analysis is to describe the configuration of vectors in a parsimonious way and also in such a way as to reveal its structural properties. Second, it was done to find out whether the construct of socio-cultural entity had been well established by the instrument. Third, it was done as an appropriate procedure for development and refinement of the SCES.

TABLE II ABOUT HERE

Principal factoring with more than five interactions was undertaken with the terminal solution determined after varimax rotation with Kaiser normalizations. Two factors emerged with 25 variables having eigen values equal to or greater than 1.0. The factor structure is as shown in Table II.

What this indicates is that the five subscales, when subjected to factoring, have emerged under two major clusters. The first cluster consists of the authoritarian and goal structure subscales,

while the second cluster consists of the three subscales of African worldview, societal expectations and sacredness of science. These two clusters, to our mind, are *social* and *cultural*, respectively, and they establish the construct of socio-cultural entity of the SCES instrument.

Table III shows the means and standard deviations for the subscales while Table IV contains the summary of the results of the analysis of variance for the variables of gender differences (male/female), class (4/5), location of school (rural/urban) and preferred science subject of study (Biology/Chemistry/Physics).

TABLES III & IV ABOUT HERE

RESULTS AND DISCUSSION

The main purpose of this study was to develop a valid and reliable instrument for measuring the socio-cultural involvement in science classes. This intention was realised with the development of the Socio-Cultural Environment Scale (SCES), which exhibited acceptable psychometric characteristics. The determination of the content validity, the internal consistency reliability and the analysis of the data using the sample of the study indicated that:

- (i) five subscales of Authoritarianism, Goal Structure, African Worldview, Societal Expectation and Sacredness of Science with a total of 30 items emerged as constituting valid indicators of a socio-cultural environment.
- (ii) the item-scale correlation coefficients ranged from 0.48 to 0.96 while intra-scale consistency for the five scales ranged from 0.70 to 0.98.
- (iii) the internal consistency reliability (alpha coefficients) of the items obtained for the sample used ranged from 0.88 to 0.96 while the factor analysis on the instrument yielded a two factor solution resulting in item loadings on each of the two major factors of the socio-cultural environment.
- (iv) the results indicated that the socio-cultural factors of Authoritarianism, African Worldview, Societal Expectations and Sacredness of Science exerted negative effects while Goal Structure exerted positive effects on the learning of science in Nigerian classrooms.
- (v) It was also found, with our sample, that the location of school (urban/rural) and gender (male/female) had effects on students' perception of the socio-cultural environment in science classrooms.

The bipolar dimensions (social and cultural) which were revealed by factor analysis endorsed the construct validity of the scale. The five elements within the two dimensions have support from research literature as being indicative of the socio-cultural environment in science classes (Fraser, 1985; Hvitfeldt, 1987; Ogunniyi, 1986). The first element in the social dimension is

authoritarianism. This is one of the most important learning variables (home or school) that is adjudged to influence classroom behaviour. The idea that "elders know all" is pervasive in African societal interaction. This is a variable to be reckoned with since science itself does not claim to have all the answers. Science is a process of finding out, and dogmatism is not part of the enterprise. The identification and measurement of the level of authoritarianism would therefore seem to be important in the teaching, guided studying and learning of science. SCES provides a valid and reliable means for conducting this measure.

The nature of the interaction with respect to goal structure is also important in the social dimension of learning in science classrooms. Cooperative group work, working individually and competing with others are the three major ways of interacting in the class. The disposition of the individual student to prefer one of these three ways is idiosyncratic. The influence of the three ways on science learning has also been shown to vary (Okebukola, 1986). It is on this basis that the measurement of the goal structure can be deemed to be important with respect to learning science in classrooms.

The second dimension of interest in this study is cultural. Several years of research have led to the documentation of the impact of culture on learning (e.g., Bajah, 1975; Dyasi, 1977). As far as science learning goes, the worldview, societal expectation and perception of science are important cultural variables (Gallagher and Dawson, 1984). The science teacher should therefore be able to measure and address these variables when instruction in science is progressing. SCES provides a valid and reliable means of such measurement. In the SCES, 18 items clustering around the three elements of African worldview, societal expectation and sacredness of science provide measures for this cultural dimension.

For the traditional (African) worldview component of SCES, traditional beliefs in supernatural forces and cosmological orientations were of interest. The traditional society holds the notion that supernatural forces do have significant roles to play in daily occurrences. The younger members of the traditional society are supposed to grow up to learn and believe these without questioning. For societal expectations, the influence of parents, peers and others in the society as being culturally coloured was the focus of measurement. The behaviour of members in the community is invariably and intimately linked to and governed by that of the larger community. Hence, an individual, particularly a school child always reviews his/her achievement as a reflection on his/her home, friends and community. Sacredness of science has to do with the general conception of the structure and nature of science. This is a pervasive view held by a large proportion of the African society in which the study of science is regarded as something special, requiring magical or weird explanation and above the average intelligence of someone from a non-western society

It would appear therefore that the major elements in the socio-cultural dimensions of the learning environment in science have been included for measurement in SCES. Teachers, administrators, counsellors and curriculum developers can use this instrument for a variety of purposes with the ultimate intention of improving the teaching, guided studying and learning of science.

Furthermore, the use of the instrument on the sample of this study revealed that authoritarianism, goal structure, traditional (African) worldview, societal expectation and sacredness of science which are measures of the socio-cultural environment, exert a lot of effect on pupils' study of science. This translates to mean that a high level of these socio-cultural factors would confound the effective learning of school science. In addition, as shown in Table IV, significant ($p < .01$) differential gender perception of the effect of socio-cultural factors in science classroom was found. Similarly, rural student were significantly ($p < .01$) more negative than urban school students about socio-cultural factors in science learning. The class in which a pupil is in and the preferred subject of study had no significant effect on views about socio-cultural measures.

EDUCATIONAL IMPORTANCE OF THE STUDY

Although the measures of validity and reliability of the SCES appear to provide some credibility and respectability to the instrument, further validation would be required to warrant sweeping generalisations. In spite of the shortcomings of the development and validation procedures of the instrument, however, the findings which appear to be worthwhile and illuminating have potential implications for educational practices.

First, a reliable and valid instrument for the measurement of the socio-cultural environment in science classrooms in an African society has emerged. Science teachers, in non-western classrooms, now have an instrument for both diagnostic and other purposes in the determination of socio-cultural factors affecting the learning of science.

Second, the influence of rapid and advanced developments in science and technology in the migration of peoples of the world has meant, more than ever before, the movement of people between traditional and western societies. Inevitably therefore, teachers faced with the difficult situation of diagnosing why pupils of non-western origin behave or seem to behave the way they do would need to determine the underlying socio-cultural factors this group of pupils have brought into the classroom from their traditional background. This instrument with some necessary modification and adaptation might prove valuable in this regard.

Third, the pursuit of studies in the socio-cultural aspects of the science classroom environment complements those in the psycho-social aspects and hence help present a comprehensive picture

of classroom climate. The total understanding of factors which inter-relate to affect educational outcomes in science learning environment bears obvious advantages and implications for curriculum development and implementation, teacher education and the understanding of how children learn science in non-western societies.

REFERENCES

- Bajah, S. T. (1975). Preparation of the secondary school science teacher for the African environment. *West African Journal of Education*. 19, 85-96.
- Champagne, A. (1984). Children's ethnoscience : An international perspective. In J. J. Gallagher and G. Dawson (eds.) *Science education and cultural environments in the Americas*. Washington, D.C.: NSTA
- Crano, W. D. and Brewer, M. B. (1973). *Principles of research in social psychology*. New York: McGraw-Hill.
- D'Ambrosio, U. (1985). Mathematics education in a cultural setting. *International Journal of Mathematics Education, Science and Technology*. 15(1), 469-477.
- Driver, R. (1979). Cultural diversity and the teaching of science. In H. Trueba and C. Barnett Mizrahi (eds.). *Bilingual teacher: From theory to practice*. Rowley Mass.: Newberry House Publications.
- Dyasi, H. (1977): "Three Groups of Skills Essential for Science Teachers", *Cambridge Journal of Education*, 7:3, 173-179.
- Erickson, F. (1984). Cultural differences and science education. In J. J. Gallagher and G. Dawson (eds.) *Science education and cultural environments in the Americas*. Washington, D.C.: NSTA.
- Ferguson, G. (1981): *Statistical analysis in psychology and education*, New York: McGraw-Hill Book Company.
- Fraser, B. J. (1986). *Classroom environment*. London.: Croom Helm.
- Fraser, B. J. (1989a). Twenty years of classroom climate work: Progress and prospect. *Journal of Curriculum Studies*. 21(4), 307-327.
- Fraser, B. J. (1989b). Instructional effectiveness: Processes on the micro level. In Bet Creemers et al (eds.). *School Effectiveness and School Improvement*. Amsterdam: Swets & Zeitlinger.
- Fraser, B. J. and Fisher, D. L. (1982): "Predicting Students' Outcomes from their Perceptions of Classroom Psychological Environment", *American Educational Research Journal*, 19, 498-518.
- Gallagher, J. J. and Dawson, G. (1984) *Science education and cultural environments in the Americas*. Washington, D.C.: NSTA.
- Glassersfield, E. von (1989). Cognition, construction of knowledge and teaching. *Synthese*, 80, 121-140.
- Good, T. (1989). Using classroom and school research to professionalize teaching. In Bet Creemers et al (eds.). *School effectiveness and school improvement*. Amsterdam: Swets & Zeitlinger.
- Hvifeldt, C. (1986). Traditional cultural perceptual style and learning: The classroom behaviour among adults. *Adult Education Quarterly*. 36(2), 65-77.
- Jegade, O. J. (1987). Socio-cultural correlates of anxiety in science classrooms: A preliminary report. Paper presented at the National Convention of the National Science Teachers' Association. Washington, D.C. 26-29 March

- Jegede, O. J. and Okebukola, P. A. O. (1988). The educology of socio-cultural factors in science classrooms. *International Journal of Educology*, 2(2), 93-107
- Jegede, O. J. and Okebukola, P. A. O. (1989). Some socio-cultural factors militating against drift towards science and technology in secondary schools. *Research in Science and Technological Education*, 7(2), 141-151.
- Knuver, A. W. M and Brandsma, H. P. (1989). Pupils' sense of well being and classroom educational factors. In Bet Creemers et al (eds.). *School effectiveness and school improvement*. Amsterdam: Swets & Zeitlinger.
- Lewin, K. (1936). *Principles of typological psychology*. New York.: McGraw.
- Maddock, M. (1981). Science education: An anthropological viewpoint. *Studies in Science Education*, 8, 1-26.
- Millar, R. and Driver, R. (1987). Beyond processes. *Studies in Science Education*, 14, - 62.
- Nussbaum, J. (1989). Classroom conceptual change: Philosophical perspectives. In Don Emil Herget (ed.). *The History and philosophy of science in science teaching*. Tallahassee: Florida State University. 278-291.
- Ogunniyi, M. B. (1988). Adapting western science to traditional African culture. *International Journal of Science Education*. 10(1), 1-9.
- Okebukola, P.A.O. (1986). Misconceptions of some biological concepts by Nigerian students and the effects of an instructional intervention. Paper presented at the 59th Meeting of NARST, San Fransisco, 28-31 March.
- Okebukola, P. A. O. and Jegede, O. J. (1990). Eco-cultural influences upon students' concept attainment in science. *Journal of Research in Science Teaching*, 27(4),. (in press).
- Scharmann, L., Harty, H., & Holland, J. (1986). Development and partial validation of an instrument to examine preservice elementary teachers' process orientation to science. *Science Education*, 70(4), 375-387.
- Scott, W. A. (1955). Reliability of content analysis: The case of nominal scale coding. *Public Opinion Quarterly*, 19(4), 321-325.
- Shrigley, R. L. (1983). Review of the test of science-related attitudes. *Journal of Research in Science Teaching*, 20(1), 87-89.
- Solomon, J. (1987). Social influences on the construction of pupils' understanding of science. *Studies in Science Education*, 14, 63-82.
- Sutton, C. R. (1980). Science language and meaning. *School Science Review*, 62, 47-56.
- Toulmin, S. (1972). *Human understanding*. Princeton: Princeton University Press.
- Walberg, H. J. (1969). Predicting class learning: An approach to the class as a social system. *American Educational Research Journal*, 6, 529-542.
- Walberg, H. J. (1986). Synthesis of research on teaching. In M. C. Wittrock (Ed.), *Handbook of research on teaching*(3rd ed.). Washington, DC: American Educational Research Association.

Table I
Inter scale Correlations for the Five Subscales of the SCES

	Authoritarianism	Goal Structure	African Worldview	Societal Expectation	Sacredness of Science
Authoritarianism	-				
Goal Structure	.33*	-			
African Worldview	.19*	.21*	-		
Societal Expectation	.33*	.24*	.17*	-	
Sacredness of Science	.19*	.11	.09	.27*	-

* significant at $p < .001$

Table II
Factor Loading of the SCES Items

Item	1	2	3	4	5
1		0.43134			
2		0.49243			
3		0.42247			
4		0.42887			
5		0.50926		0.30992	
6		0.54711			
7		0.47314	0.37799		
8		0.59605			
9		0.63612		0.30336	
10		0.39698			
11		0.51287			
12		0.42391			
13	0.68965				
14	0.64175				
15	0.60058				
16	0.67201				
17	0.67676				
18	0.70404				
19	0.68321				
20	0.79819				
21	0.76739				
22	0.72938				
23	0.75285				
24	0.61131				
25	0.62210				
26	0.66071				
27	0.64886				
28	0.60944				
29	0.64286				
30	0.68906				

Table III

Mean and Standard Deviation of the subscales in the SCES

Subscale	Mean	S.D
Authoritarianism	8.02	1.90
Goal Structure	7.53	2.35
Traditional (African) Worldview	6.53	1.91
Societal Expectation	9.12	2.44
Sacredness of Science	6.38	2.07

Table IV
Summary of ANOVA Results for the Independent Variables

Variable	DF	F	Signif. of F
Gender (male/female)	1	14.03	.001*
Class (form 4/ form 5)	1	1.98	.159
location of school (urban/rural)	1	31.29	.001*
Subject preference (Biology/Physics/Chemistry)	2	1.07	.344

* $p < .01$